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Speed Control and Monitoring of an AC Motor by Wireless Communication Using DTMF Decoder Technique

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Abstract: *The main idea of this paper is to control the speed of an AC motor by wireless communication using DTMF decoder technique which is implemented by an embedded controller. In this we are using Mobile unit for wireless communication. Dual-tone multi-frequency (DTMF) signaling is used for telephone signaling over the line in the voice-frequency band to the call switching center. To meet this requirement we have designed an embedded system [1].*

Keywords – *Embedded Controller, AC Motor, LCD Module, Mobile unit DTMF decoder, Keil Compiler.*

I. Introduction

In this study, remote control of an Induction motor has been implemented by using a standard DTMF mobile phone. To drive the motor a digitally controlled drive system has been designed. Then a tone decoder circuit and microcontroller have been added between output of a mobile phone and the drive system of the motor. This system is flexible to be controlled with both GSM and DTMF based phones. With the developed drive and control system the overall control of the motor has been achieved. The system has been tested for different speed, position and direction conditions successfully. The experimental results verify that the DTMF controlled drive system is highly effective, reliable, proper and applicable to achieve remote control of the motor. This study gets novel and important point of view for DTMF based remote control applications addition to the control of motors [1].

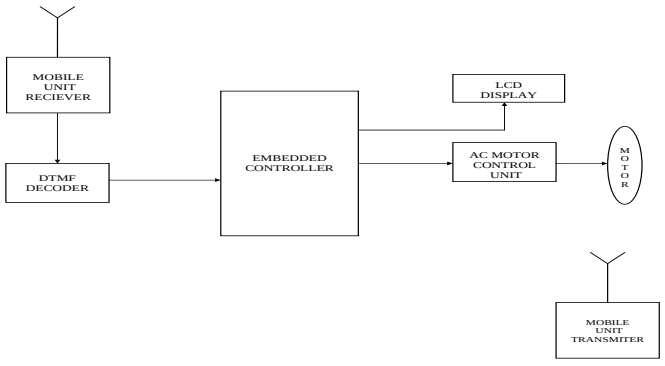
II. FUNCTION OF DTMF

The version of DTMF used for telephone tone dialing is known by the trademarked term Touch-Tone. Other multi-frequency systems are used for signaling internal to the telephone network. A machine that converts electrical power into mechanical power is called Motor. Power devices are used in speed control circuits of AC motors to get high Reliable operations at large currents.

Various methods are available to control the speed of the AC motor; here we Control the motor speed by applying the DTMF decoder technique.

In this system our mobile signals are goes to DTMF decoder. And this DTMF decoder is interfacing with the embedded controller. The controlling device controls the speed of the motor. Here there are mobile keys, which serve the purpose of increasing or decreasing the speed of the motor. This speed of the motor varies in steps according to the selection of key over the particular range.

BLOCK DIAGRAM:



III. FUNCTIONAL BLACK DIAGRAM

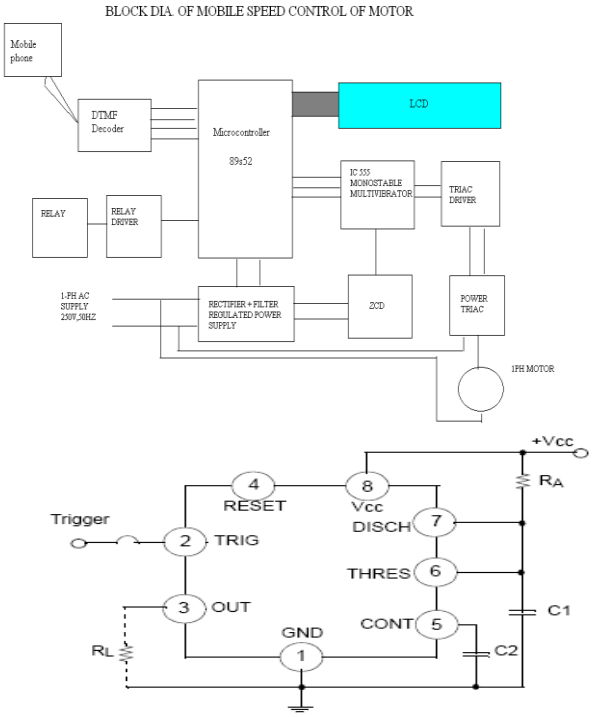


Figure 1. Monoatable Circuit

RECTIFIER + FILTER + REGULATED POWER SUPPLY
The output from transformer is 9V Ac we require for our circuit because all the circuit work only DC. So with the help of rectifier we rectify & filtered this signal so as to get pure DC from this circuit. Out from rectifier & filter circuit is unregulated so by using regulator output from this is fixed 5v is maintained by this block.

ZCD (Zero crossing detectors)
This is used of sampling purpose so to fire the gate signal pulses with respective reference signal.

IC555 (Monostable Multivibrator)
This IC generates the PWM signal (pulse width Modulation). But output pluses depend on microcontroller signal. This signal is connected to triac driver circuit.

Triac Driver
The output from IC555 is can PWM signal these signals boosted by triac driver IC & also maintain the Isolation of circuit from lower circuit to higher circuit.

Triac
It is switching device which can operates whenever we are giving gate pulses on it. It has three terminal devices.

Microcontroller
It is 40 pin IC which can operated as per programmed written. The all of execution will be done by this microcontroller.

LCD (Liquid Crystal Display)
LCD is Display device this can display status of motor & load.

DTMF Decoder
This IC is a frequency tuned IC. It generates the digital output whenever any key pressed from caller.

IV. MONOSTABLE OPERATION

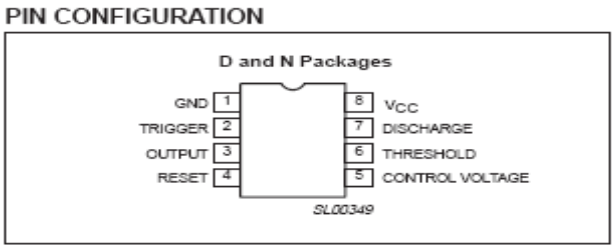


Figure 1. Pin configuration

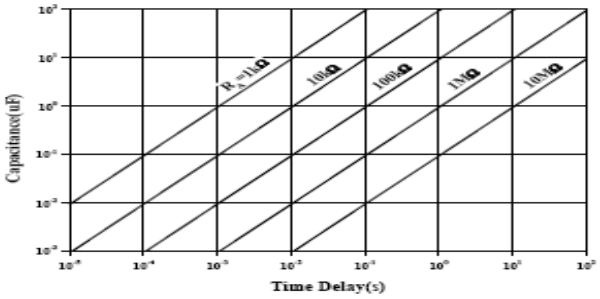


Figure 2. Resistance and Capacitance vs. Time delay(td)

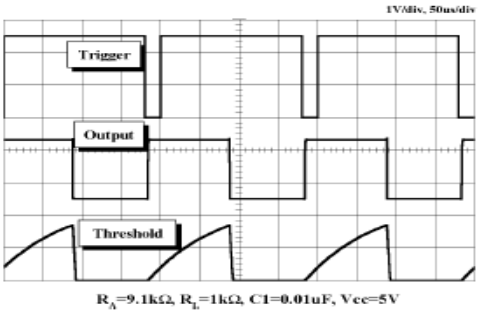


Figure 3. Waveforms of Monostable Operation

The 555 monolithic timing circuits is a highly stable controller capable of producing accurate time delays, or oscillation. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, the free running frequency and the duty cycle are both accurately controlled with two external resistors and one capacitor. The circuit may be triggered and reset on falling waveforms, and the output structure can source or sink up to 200 mA.

Figure 1 illustrates a monostable circuit. In this mode, the timer generates a fixed pulse whenever the trigger voltage falls below Vcc/3. When the trigger pulse voltage applied to the #2 pin falls below Vcc/3 while the timer output is low, the timer's internal flip-flop turns the discharging Tr. off and causes the timer output to become high by charging the external capacitor C1and setting the flip-flop output at the same time. The voltage across the external capacitor C1, VC1 increases exponentially with the time constant t=RA*C and reaches 2Vcc/3 at td=1.1RA*C. Hence, capacitor C1 is charged through resistor RA. The greater the time constant RAC, the longer it takes for the VC1 to reach 2Vcc/3. In other words, the time constant RAC controls the output pulse width.

When the applied voltage to the capacitor C1 reaches 2Vcc/3, the comparator on the trigger terminal resets the flip-flop, turning the discharging Tr. on. At this time, C1 begins to discharge and the timer output converts to low [7].

V. Astable Operation

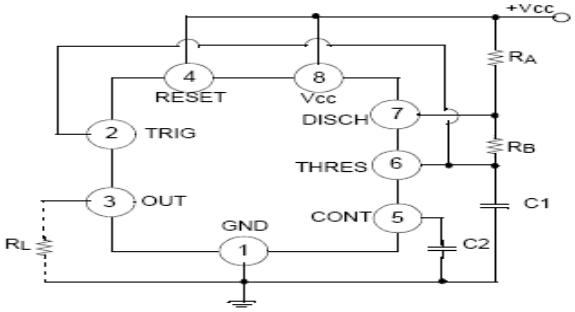


Figure 5. Astable Circuit

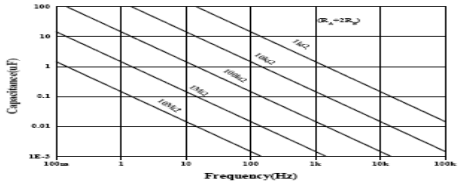
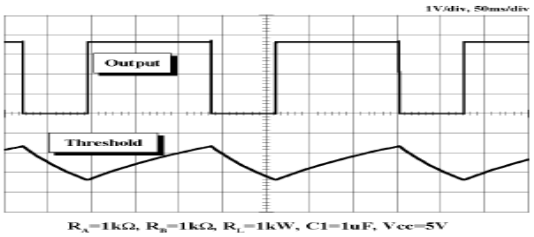


Figure 6. Capacitance and Resistance vs. Frequency



R_A=1kΩ, R_B=1kΩ, R_L=1kW, C1=1uF, Vcc=5V

Figure 7. Waveforms of Astable Operation

An astable timer operation is achieved by adding resistor RB to Figure 1 and configuring as shown on Figure 5. In astable operation, the trigger terminal and the threshold terminal are connected so that a self-trigger is formed, operating as a multivibrator. When the timer output is high, its internal discharging Tr. turns off and the VC1 increases by exponential function with the time constant (RA+RB)*C. When the VC1, or the threshold voltage, reaches 2Vcc/3, the comparator output on the trigger terminal becomes high, resetting the F/F and causing the timer output to become low. This in turn turns on the discharging Tr. and the C1 discharges through the discharging channel formed by RB and the discharging Tr. When the VC1 falls below Vcc/3, the comparator output on the trigger terminal becomes high and the timer output becomes high again. The discharging Tr. turns off and the VC1 rises again [7].

In the above process, the section where the timer output is high is the time it takes for the VC1 to rise from Vcc/3 to 2Vcc/3, and the section where the timer output is low is the time it takes for the VC1 to drop from 2Vcc/3 to Vcc/3.

Consequently, if the timer operates in astable, the period is the same with

'T=tH+tL=0.693(RA+RB) C1+0.693RBC1=0.693(RA+2RB) C1' because the period is the sum of the charge time and discharge time. And since frequency is the reciprocal of the period, the following applies [4].

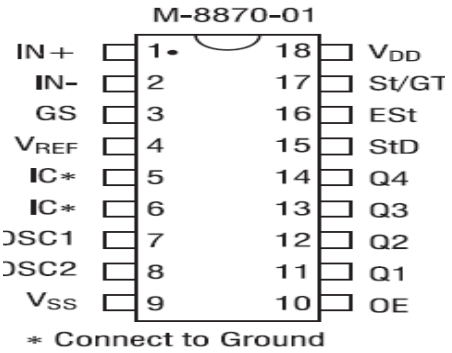
$$\text{frequency,} \qquad f = \frac{1}{T} = \frac{1.44}{(R_A + 2R_B)C_1}$$

VI. DTMF DECODER 8870

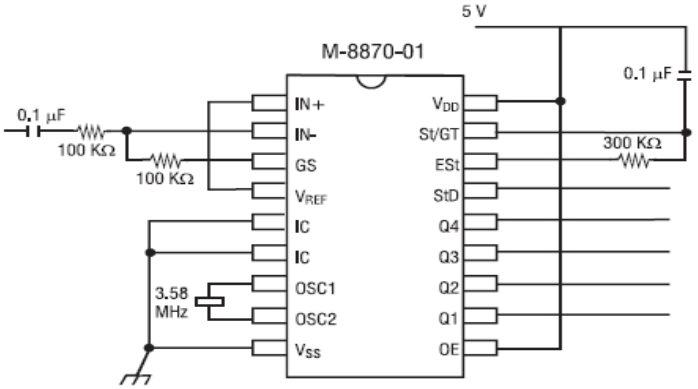
M-8870 DTMF Receiver

- Low power consumption
- Adjustable acquisition and release times
- Central office quality and performance
- Power-down and inhibit modes (-02 only)
- Inexpensive 3.58 MHz time base
- Single 5 volt power supply
- Dial tone suppression
- Applications include: telephone switch equipment, remote data entry, paging systems, personal computers, credit card systems

The M-8870 is a full DTMF Receiver that integrates both band split filter and decoder functions into a single 18-pin DIP or SOIC package. Manufactured using CMOS process technology, the M-8870 offers low power consumption (35 mW max) and precise data handling. Its filter section uses switched capacitor technology for both the high and low group filters and for dial tone rejection. Its decoder uses digital counting techniques to detect and decode all 16 DTMF tone pairs into a 4-bit code. External component count is minimized by provision of an on-chip differential input amplifier, clock generator, and latched tri-state interface bus. Minimal external components required include a low-cost 3.579545 MHz color burst crystal, a timing resistor, and a timing capacitor. The M-8870-02 provides a "power-down" option which, when enabled, drops consumption to less than 0.5 mW. The M-8870-02 can also inhibit the decoding of fourth column digits (see Table) [1][6].



F_{LOW}	F_{HIGH}	Key (ref.)	OE	Q4	Q3	Q2	Q1
697	1209	1	H	0	0	0	1
697	1336	2	H	0	0	1	0
697	1477	3	H	0	0	1	1
770	1209	4	H	0	1	0	0
770	1336	5	H	0	1	0	1
770	1477	6	H	0	1	1	0
852	1209	7	H	0	1	1	1
852	1336	8	H	1	0	0	0
852	1477	9	H	1	0	0	1
941	1336	0	H	1	0	1	0
941	1209	*	H	1	0	1	1
941	1477	#	H	1	1	0	0
697	1633	A	H	1	1	0	1
770	1633	B	H	1	1	1	0
852	1633	C	H	1	1	1	1
941	1633	D	H	0	0	0	0
ANY	ANY	ANY	L	Z	Z	Z	Z
L = logic low, H = logic high, Z = high impedance							



VII. LCD DISPLAY

Various display device such as seven segment display. LCD display, etc can be interfaced with microcontroller to read the output directly. In our project we use a two line LCD display with 16 characters each. Liquid crystal Display (LCD) displays temperature of the measured element, which is calculated by the microcontroller. CMOS technology makes the device ideal for application in hand held, portable and other battery instruction with low power consumption [5].

GENERAL SPECIFICATION

- Drive method: 1/16 duty cycle
- Display size: 16 character * 2 lines
- Character structure: 5*8 dots.
- Display data RAM: 80 characters (80*8 bits)
- Character generate ROM: 192 characters
- Character generate RAM: 8 characters (64*8 bits)
- Both display data and character generator RAMs can be read from MPU.
- Internal automatic reset circuit at power ON.
- Built in oscillator circuit.

JP1/JP14 Pins 1 – 8	**Description**	**JP1/JP14 Pins 9 -16**	**Description**
Pin1	Ground	Pin9	D2 (Not Used)
Pin2	VCC (+5)	Pin10	D3 (Not Used)
Pin3	Contrast	Pin11	D4
Pin4	Data/Command (R/S)	Pin12	D5
Pin5	Read/Write (W)	Pin13	D6
Pin6	Enable (E1)	Pin14	D7
Pin7	D0 (Not Used)	Pin15	VCC (LEDSV+)
Pin8	D1 (Not Used)	Pin16	Ground

Description	Keyboard Code	ASCII or Decimal Value
Display custom character0-7	Ctrl-@ - Through- Ctrl-G	0 – 7
Backspace	Ctrl-H	8
Horizontal Tab	Ctrl-I	9
New Line	Ctrl-J	10
Vertical Tab	Ctrl-K	11
Form Feed (Clear Screen)	Ctrl-L	12
Carriage Return	Ctrl-M	13
Reset Controller	Ctrl-N	14
Set Geometry	Ctrl-O	15
Set Tab Size	Ctrl-P	16
Set Cursor Position	Ctrl-Q	17
*Not Used	*****	**
Set Contrast	Ctrl-S	19
Set Backlight	Ctrl-T	20
Command Escape	Ctrl-U	21
Data Escape	Ctrl-V	22
Raw Data Escape	Ctrl-W	23
*Not Used	*****	**
Display an ASCII Character	None	22 – 255

VIII. CIRCUIT DIAGRAM & ITS WORKING

Speed control of motor using mobile phone is microcontroller based project work on low voltage circuit. In this work motor speed, motor ON/Off & Load is switched from any where from the world.

In this if we call to our mobile circuit then following functions will be done

- If press 1 then motor will ON with Low speed.
- If press 2then motor will ON with MID speed.
- If press 3then motor will ON with HIGH speed & Load ON
- If press 5then motor will OFF Motor & Load

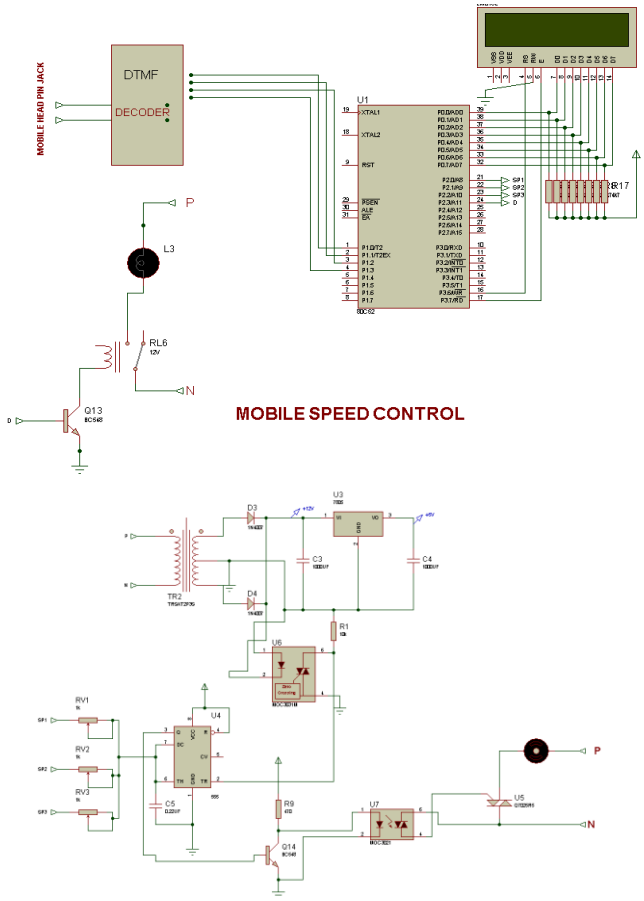
In this circuit uses microcontroller 89S52, Power supply, DTMF 8870, relay Driver, PWM generator, Triac Driver, Triac

In this the speed of motor i.e. voltage control method by using mobile phone. In this work we use DTMF 8870 IC for detecting of mobile signal pressed by caller from remote place. The mobile output signal is RF this signal is converted in to binary digital form using this 8870 IC.

Mobile button 1 - Data Out from 0001h
Mobile button 2 - Data Out from 0010h
Mobile button 3 - Data Out from 0011h
Mobile button 5 - Data Out from 0101h
The output of binary numbers from DTMF IC is compared with microcontroller stored value & takes the corresponding decision. I.e. Speed of motor & load on / off etc.

The output from 89s52 is connected to PWM generator circuit; it is a simple monostable multivibrator works on PWM control mode. It generates the pluses depends on input signal from DTMF. The output of IC555 is given to traic driver via amplifier BC548 transistor. This Traic driver drives the Power Traic as per data given from microcontroller & DTMF circuit [7].

Traic is connected in series with motor as shown circuit dia. Also anther function is included in our circuit is to display status of working & one load point on / off from remote mobile [3].



I. FUTURE MODIFICATION

- Adding of number of load control by using programming.
- Auto Fault finding by using CT & PT.
- We design load up to 8 Amp Possible to increase the load range by use higher value of Triac.

IX. ADVANTAGES

- Wireless Control from Remote places
- Easy of operation
- By using any mobile possible to on/off motor.
- Speed of motor varies simple pressing remote mobile buttons.
- Display the status of current operation.

X. DISADVANTAGES

- If receiver mobile range not available then does not possible to communication between them.

XI. CONCLUSION

To control the speed of an AC motor by wireless communication using DTMF decoder technique. The applications for DTMF signaling are tremendous. DTMF offers highly reliable, cost effective signaling solutions which require no development effort on the user's part. This signaling technique has been applied to a multitude of control and data communications systems. Wireless Control from Remote places, Easy of operation by using any mobile possible to on/off motor. Man mistake has been reduced Speed of motor varies simple pressing remote mobile buttons. Display the status of current operation. Reduce maintenance. Fault detection is easy.

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